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ABSTRACT

The Open Source Teaching Project (OSTP) is an attempt to apply a variant of the successful open source software approach to the development of educational materials. Open source software is software licensed in such a way as to allow anyone the right to modify and use it. From such a simple premise, a whole industry has arisen, most notably in the form of the wealth of companies supporting GNU/Linux. However, open source content initiatives, at least in the educational context, have so far failed to achieve popular, widespread success to the extent that open source software has. This research note briefly describes a development model based on the open source software phenomenon, identifying those key features that are potentially generalizable to other industries; in particular, the creation of 'preversioned', reusable components, and the demonstration that giving away intellectual property can make commercial sense. These aspects are developed in the context of the production and distribution of educational materials, and from this identify the "hard problems" (i.e., the major research issues) that have been identified within the OSTP are identified. Includes one figure. An appendix includes "The Proposed e-University (Notes for the OSTP on HEFCE document 44/00)." (Author)

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The Open Source Teaching Project (OSTP): Research Note

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Abstract

The Open Source Teaching Project (OSTP) is an attempt to apply a variant of the successful open source software approach to the development of educational materials. Open source software is software licensed in such a way as to allow anyone the right to modify and use it. From such a simple premise, a whole industry has arisen, most notably in the form of the wealth of companies supporting GNU/Linux. However, open source content initiatives, at least in the educational context, have so far failed to achieve popular, widespread success to the extent that open source software has. In this research note, I shall briefly describe a development model based on the open source software phenomenon, identifying those key features that are potentially generalisable to other industries; in particular, a) the creation of 'preversioned', reusable components; and b) the demonstration that giving away intellectual property can make commercial sense. I shall develop these aspects in the context of the production and distribution of educational materials, and from this identify the 'hard problems' (i.e. the major research issues) that have been identified within the OSTP.

Keywords: *open source licenses, metadata (IMS, Dublin Core), learning objects, Open Source Teaching Project, OSTP*

URLs: *http://www.opensourceteaching.org*
http://ostp.open.ac.uk

Related OU projects: *CURVE, SOURCE, ROUTES, D3E*

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Disclaimer: *the opinions expressed in this document do not necessarily reflect the opinions of the Open University or policies of the Open Source Teaching Project (www.opensourceteaching.org).*

Acknowledgements: *this work has been pursued under the auspices of the Open Source Teaching Project (www.opensourceteaching.org) and represents a personal, distilled view of the many project team discussions held since it began. The current project team includes: Ray Corrigan, Ian McCrum, Nick Meara, John Naughton, Tony Nixon, Ian Stevenson, Colin Watt, Martin Weller.*

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Major Issues: Summary

Licensing Issues:

the license must be:

- acceptable to individual authors;
- acceptable to individual users;
- acceptable to institutions submitting content;
- acceptable to institutions exploiting content;
- compatible with the open philosophy;
- compatible with other license types.

Constitution:

the constitution should consider both OSTP management issues and potentially OSTP initiative issues:

- the range of participant categories;
- content flow from submission to use;
- project management concerns (a) OSTP infrastructure; b) OSTP initiatives);
- the preferred communication channels;
- necessary decision making processes.

Technical Infrastructure:

there are many concerns relating to technical infrastructure:

- discussion systems;
- metadata specification;
- restricted vocabulary definition;
- submission management;
- content review/flow management from submission to use;
- citation management.

Business Models:

to encourage use of the system, the OSTP should demonstrate possible business models for the use and exploitation of OSTP sourced materials, in particular:

- maintenance of otherwise unsupported courses;
- reversioning course materials;
- a development model appropriate for the e-university.

Content Models

User Models

0 Preamble

In August, 2000, I had been looking at ways of using open source software development models for producing web-based services and applications, when a chance conversation with Tony Nixon[1] alerted me to the beginnings of a related project he was involved in with John Naughton[2] and Ian Stevenson[3], a project soon after named the Open Source Teaching Project[4] (OSTP). Since then, a working group containing members from several UK universities has been developing the philosophy behind, and infrastructure required to support such a project. This research note describes some of the major research issues that have been identified during that time[5]; an official OSTP report is currently in preparation. Note that the terminology used herein to describe various aspects of the OSTP philosophy and technical infrastructure is still in a state of flux.

1 Introduction

Open source education is a move towards making educational materials freely available to all. The OSTP is an attempt to provide a philosophical framework and technological infrastructure to support open source education. The aim of the OSTP is provide a quality assured repository of educational materials that are freely submitted by a community of practitioners, and that can be freely used by anyone else. There are several important ideas implicit here. The first is that authors (in the first instance) will submit material to the repository that can be revised or reused by others. The second is that there will be some way of guaranteeing the quality of materials in the repository. The third is that there will be some way of extracting relevant materials from the repository. There are many other issues as well that must be taken into account - for instance, why would anyone want to submit materials? how can materials be used? and who would want to use them anyway?

Since educational materials are themselves essentially commercial publications, it would seem that the OSTP is suggesting that 'academic companies' commit commercial suicide by giving away the intellectual property rights to the material they produce. But this is not necessarily the case, as the open source software industry has already demonstrated in the way it manages its intellectual property.

Just because open source software is made freely available does not mean there are no business opportunities associated with it. Indeed, in the software industry several business models surrounding open source models arise from the observation that 'software is largely a service industry operating under the persistent but unfounded delusion that it is a manufacturing industry' (Raymond, Magic Cauldron[6]). So for example, businesses can offer training or support services; one major specialist book publisher supplies professionally produced documentation, originally sourced within the context of the open source documentation project.

At this point, I should mention that although this research note is about open source education, not open source software, I will often refer to the open source software model. This serves several purposes: for readers familiar with open source software, I hope to demonstrate the parallels between that approach and open source educational materials. For readers

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[1] mailto:t.p.nixon@open.ac.uk
[2] mailto:j.j.naughton@open.ac.uk
[3] mailto:i.j.stevenson@open.ac.uk
[4] http://www.opensourceteaching.org
[5] For 'official' OSTP comment, please contact John Naughton (j.j.naughton@open.ac.uk) in the first instance.
[6] Eric Raymond (ers@thyrsus.com) The Magic Cauldron (available from http://www.tuxedo.org/~esr/writings/).

unfamiliar with the open source software model, the approach offers something stronger than simply anecdotal evidence that an open methodology can, and does, work in the real world. For example, the software industry clearly demonstrates that a free flow of intellectual property can benefit the industry as whole, but this was not widely realised until recently, as I shall suggest next.

Whilst computer software has been freely shared between typically academic software programmers since the earliest days of electronic computing, commercial software has tended to be fiercely protected. Software that runs on your PC tends to be sold in a ready-to-run, *compiled* form. This compiled form is understandable by your computer hardware, but is not human-readable: its secrets are safe. What is human readable is the software's source code, the instructions that are written by human programmers. When you have access to the source code, you have access to the intellectual property it contains. And in open source software, your right to have access to the source code is enshrined in the license terms under which that software is released. Perhaps understandably, software companies tended to be reluctant to open up their software, because this meant their competitors could see exactly how their software worked and go on to exploit those tricks in their own software. But there is an upside to opening up software, and that has to do with reliability. Having access to source code means that you are allowed to modify it; and this has significant consequences for the quality of open source software because it means that if the software doesn't work properly, or doesn't do quite what you wanted to, you can mend it, or modify it; and because the right of future users to have access to your modifications is also guaranteed, there is a potential for a virtuous circle to form in which a community of users mutually support and improve a piece software.

This idea of a virtuous circle in which a community of users contribute and incrementally improve upon a common set of resources lies at the heart of the OSTP.

In the next section (section 2), I will provide some context for the whole discussion by presenting a stylised view of a higher education institution and their potential customers. In section 3, I shall review some of the intellectual property issues that have been identified within the context of the OSTP, and then go on to briefly identify some of the constitutional issues (section 4). In section 5, I will describe some of the requirements of the technical infrastructure that is needed to support the OSTP and the metadata used to mark up submissions, before suggesting typical user interactions with it. The question of how incremental improvement to materials can be facilitated is the topic of section 6, in which I speculate on the nature of learning objects. In section 7, I shall consider some of the potential business models that could exist in an open source education economy, including the idea of using OSTP to manage course maintenance. Finally, in section 8, I will review related projects and suggest why OSTP is different.

2 The Wider Context

Before I consider the research issues that the OSTP has been explicitly involved with, it will be useful to provide some sort of context in terms of the envisioned OSTP process and the market setting that open source education could exist in. The descriptions are somewhat stylised, and are not necessarily complete. Whilst I have concentrated on higher education, the model is intended to be applicable at all educational levels and to all subject areas

2.1 'Stuff on the web'

There is undoubtedly an increasing volume of educational material available on the web, and much of it is being made freely available. Along with the problem of how this material can be searched in a sensible way is the question of how to determine the quality of the material. For example, the widespread availability of low quality educational materials on the web has been

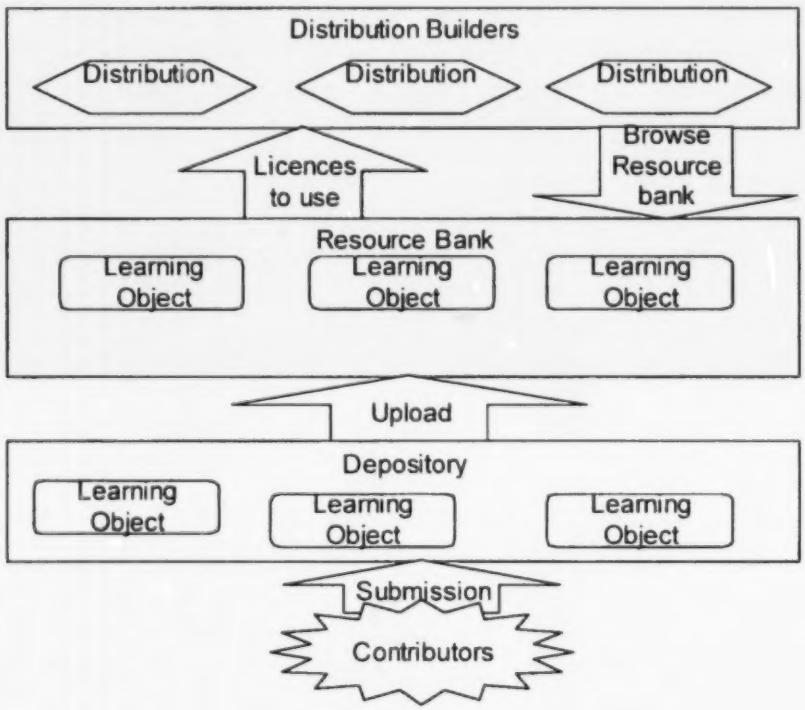
identified as one possible obstacle facing the roll-out of the UK's proposed e-University. The Open Source Teaching Project addresses these two issues by positing a centralised repository of freely available, searchable quality controlled materials[7].

2.2 The Open Source Teaching Project

The OSTP model is based on the open source software development model as used to produce GNU/Linux distributions.

In the first instance, educators will submit educational materials to a depository[8]. Community review of these materials will check their quality, a model loosely based on the peer review model that is applied to academic conferences or journals. One major difference is that improvements to materials in the depository may be made by any member of the community by checking the material out and resubmitting a revised version of it. You might think of the depository as corresponding to the set of beta release open source software programs.

Figure 1: The Basis of the Open Source Teaching Project (produced by Colin Watt for the OSTP, 17/10/00). Note that the terminology has not been fixed. For the latest version, see the OSTP website.



[7] A distributed, 'Napster-like' approach is also considered later n this research note.

[8] Ideally, the items submitted to the OSTP depository would correspond to learning resources or 'learning objects' (LOs, whatever they are: I will return to this in section 6). For now, you might think of a learning object as a standalone component suitable for use in distance education. Distance education materials are structurally different to a set of lecture notes, say, (though they may include reprinted lecture notes), because along with the actual teaching material they typically describe a set of learning objectives as well as presenting means by which students can self-assess their understanding. More realistically, it is likely that submitted items will be in the form of learning resources (such as simple documents, computer programs, audio-visual materials, exercises and self-assessment questions (SAQs) etc.). Another intention is that materials will be appropriate for use in all delivery contexts.

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Once the quality of the material has been assured, it may be promoted to the resource bank (corresponding to an official release of a particular open source software program or tool). The promotion process requires that the item being promoted is marked up with appropriate metadata, which is essential for supporting reuse of resources. The resource bank thus represents a searchable, quality controlled store of educational materials.

Materials in the resource bank may now be extracted by distributors (who may also use material from the depository, though its quality will not be guaranteed in the same way). The process of building a course distribution, for example, from a set of learning objects is akin to the production of a GNU/Linux distribution from a set of stable open source software programs. Ideally, the resource bank would contain enough material to build complete courses, though it is more likely that it will just provide components for inclusion in courses.

2.3 Higher Education institution

The institution is a provider in the growing distance education market and is likely to be a distributor of OSTP sourced materials. It may be viewed as competing in *four* key product areas:

- *published educational materials*; as a publisher, the institution will be involved in managing authors, editors and designers, as well as marketing finished wares;
- *support services*: e.g. tutorial support; local infrastructure and central administrative services;
- *examination and assessment*;
- *accreditation*: the capability to provide accreditation services (signing-off on qualifications managed by other institutions).

Additional factors are typically out-sourced; e.g. printing of published material.

2.4 Individual Teachers

As well as institutions adopting OSTP materials as a matter of policy, individual teachers may also choose to make use of the materials. This approach is most likely to happen in cases where teaching material is developed by an academic for their own use. The institutional adoption approach is more in keeping with organisations that publish materials, often for delivery by many different people; for example, distance education organisations that offer tutor support, or commercial training organisations.

2.5 Student end-users

The student end-users are the ultimate recipients of the OSTP sourced material. They are the purchasers of distributions compiled and sold by educational institutions and used by individual teachers. There are several possible types of distribution purchaser, for example:

- some students may want to simply acquire knowledge for its own sake - their needs can be handled by an educational publisher;
- some students want guidance through a subject area; at one extreme, this may be catered for reading according to a fixed syllabus; at the other extreme, it may require tutor support and/or residential schools;
- some students want qualifications - these students need accredited providers that can deliver the necessary examination/assessment;
- some students may extract materials for their own use.

3 Intellectual Property Issues

In this section, I will consider some of the licensing issues that have been raised within the OSTP. The assumption is that all material submitted to the OSTP is covered by a single, as yet undecided upon, open OSTP License. The e-University, and its commentators, have identified IPR/copyright issues as a major area of concern. However, in that case, copyright is used to protect author rights for commercial gain, requiring sophisticated systems for identifying royalty payments, for example. The open license arrangement potentially reduces the complexity of rights management (although as we shall see later, managing author credits is still desirable in the OSTP).

Ideally, only material that is licensed using the OSTP license can be submitted to the depository (in fact, the upload process would associate the license with the uploaded material, if it is not already so licensed).

There are likely to be other parties interested in the IPR discussions (for example, librarians/information science professionals) and they should be identified and included in decisions at the earliest possible time.

3.1 Copyright

An important point to mention is that open source materials are copyrighted by their author(s) and as such the author retains their intellectual property rights over the material. What happens next is that the author, as copyright holder, waives many of their rights under the terms of an open license. In addition, these licenses typically guarantee certain rights to the *user* of the material.

3.2 Open source software licenses

As far as open source software goes, there are several open licenses available, although they share many common features:

- firstly, all open licenses ensure that the materials may be freely distributed, although in certain cases a charge may be made to cover duplication costs of certain media, for example;
- secondly, the source code must always be made available; even if a piece of software is distributed in a compiled form, (which is often the case - compiling source code for a particular machine can often be a laborious process), the source should still be available somewhere;
- thirdly, the license protects the user's right to produce modified works; this is essential if the evolutionary/incremental modification approach to software improvement is to work.

The major difference between open source software licenses are those that are copyleft licenses, and those that aren't. A copyleft license requires that modified works are covered by the same license (examples include the GNU General Public License (GNU GPL), the BSD license and the W3C Software Notice); non-copyleft licenses (such as the Netscape Public License) do not have this requirement, which means that a modified open source work can be released as a closed work[9].

3.3 Open content licenses

There is less choice amongst currently available licenses as far as open content licenses go. Here, we are taken content to refer to works that are typically covered by copyright, such as documents, images or audio-visual materials. Of particular interest to the OSTP are open

[9] You can get all these licenses from http://www.gnu.org/philosophy/license-list.html

(free) documentation licenses[10], such as the GNU Free Documentation Licence, or the OPL. These licenses offer similar sorts of protection to the *user* as do the open software licenses:

- the right to copy material, though different licensing requirements may apply to users making large or small numbers of copies (a large number of copies may result when a publishers produces a popular book containing some openly sourced material, for example);
- the right to make modifications (this includes the right to make translations of the licensed material);
- in some cases, clauses are introduced into the license by the author to protect the integrity of the work; for example, invariant sections or cover items may be specified, and this may not be changed by users;
- because a document may be worked on by many people over a period of time, a document history detailing a list of contributors to the document may be associated with it; these histories are incremental and must be passed on along with the document.

For document submission, XML (eXtensible Markup Language) appears to offer the best format for developing cross referenced, text based documents for delivery in a variety of forms. XML also facilitates the generation and management of metadata (such as generating tables of contents from chapter headings) which is necessary for the promotion of content from the depository to the resource bank. Ideally, OSTP submissions would come in the form of XML documents, but this is unlikely to be the case for many years yet (the expectation is that HTML and wordprocessor documents, Java applets and Macromedia Flash movies will make up the majority of early submissions). However, assuming that there will be a migration towards XML documents, it is worth taking some time to ensure that the OSTP IPR notices will be forward compatible.

Since XML can be thought of as comprising 3 components, we may use these to inform the way appropriate licenses are developed and the scope they must cover:

- *Document Type Definition* (DTD) - this defines the logical structure of the document; e.g. it's a book with chapters, chapters have a title and one or more sections, sections have... etc.; XML is used to markup text according to its role in the document; in addition, the *Resource Description Format* (RDF) provides a way of managing and exploiting metadata and relations between a document's internal objects;
- *eXtensible Stylesheet Language* (XSL) - defines the formatting styles (e.g. font type or size, emphasis) that are applied to marked up elements; different style sheets may be used to display a document on different media; where the same object is used in different distributions, style sheets and navigation structures will distinguish distributions;
- *XLink* - defines the various ways in which hyperlinks between can be defined, including forward and backward links, and two way links; another strategy, known as *transclusion*, allows material stored in one document to be included in a second document, where it behaves to all intents and purposes as if it was a part of that second document.

That these components should be considered when creating the license is illustrated by the hypothetical examples of material being submitted to the OSTP that is defined according to a proprietary DTD, or material that is distributed under a closed style sheet. In each case, we would not want side effects of the license to prevent this sort of activity.

It is also worth noting that the W3C (the World Wide Web Consortium) IPR notices[11] treat software and document DTDs (document type definitions) differently under a separate license to documents (as well as regulating the use of member organisation trademarks).

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[10] Available from http://www.gnu.org/philosophy/license-list.html#TOCFreeDocumentationLicenses
[11] http://www.w3.org/Consortium/Legal

3.4 The importance of having an appropriate license

The licensing issue is important to the success of the OSTP for at least the following reasons:

- the license must support the 'open philosophy' freedoms;
- the license should be compatible with other open content licenses, so that this open material can be used within the OSTP context;
- the license must be palatable to institutions who may either: a) seek to use the OSTP as a resource (e.g. by using the materials in producing their own courses; or b) wish to commit resources to the OSTP, (e.g. by committing legacy materials, or staff time, to the project.

The first two points address the immediate concerns of individuals; the last point addresses the immediate concerns of institutions. Unlike many other open source education initiatives, by acknowledging corporate/institutional involvement for both sourcing and use of the open materials, we hope from the outset that OSTP will provide a scalable model and thus ultimately be able to make a significant contribution to the worldwide educational community.

3.5 Relationship with other legal instruments

The license must be 'clean' in the sense that OSTP licensed materials should not taint materials they are distributed with, but which are differently licensed. This includes not only materials released under completely different licenses, but also materials released under the OSTP license but with different rider clauses attached.

Along with producing the generic OSTP license, it will be useful if the OSTP also maintains (and helps author) derived/OSTP compatible licenses for distributors wishing to release materials under a closed license. Possible sources of inspiration include the non-copyleft licenses used by Netscape and IBM, for example, as well as the end-user license agreements drawn up by various electronic journal publishers.

Contractual obligations of authors may also interact with the OSTP license. For example, many academic contracts require academics to assign copyright over material they create in the course of their working duties to their employer[12].

If the OSTP databases are hosted in the UK, it is likely that they will have to be registered under the current data protection legislation. Development of a privacy statement describing how personal data will be both collected and used within the OSTP is also necessary; (for example, data is collected explicitly during user registration, and implicilty in metadata entry, or logs of materials downloaded by a logged in user).

3.6 Copyright ownership

Ideally, content submissions to the OSTP should be made with copyright assigned to the actual author(s) of the piece, rather than their institution, although an affiliation will also be logged with each submission. As mentioned previously, this raises a potential area of conflict with current academic contracts in which the copyright of certain materials is contractually passed to the author's employer. One reason for insisting on such contractual clauses is to protect the employer's right to exploit the work produced by an author whilst they were an employee if, for example, the author joins another institution. However, as described above, open licenses guarantee the rights of the *user* of openly licensed materials to modify and distribute those materials. What this means is that if an employer contractually requires an author to license their works under an open license, the employer is guaranteed the right to make use of those works.

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[12] A review of the Open University academic contract in light of the OSTP license is provided for internal OU use in Appendix OU-Academic-Contract.

3.6 OSTP License preamble

The major issues that must be addressed in the first instance by the license adopted by the OSTP are covered by the preamble to OSTP License, which is currently only available in the form of a draft discussion document:

The Open Source Teaching Project License (OSTPL) has been designed to facilitate the development and use of open source teaching materials, whatever their form. The 'open source' phrase originally derives from the open source software movement which makes program source code available along with compiled programs. In the Open Source Teaching Project (OSTP), the phrase relates more to the way in which the OSTP resource bank acts as a source of open teaching materials that may be freely and openly used by those who accept the terms and conditions of this license.

For the purposes of this document, elements refer to documents, software, images, audio files and any other media; a collection of elements is also an element and may be copyrighted (e.g. in the same way that an editor may assert copyright over a collection of poems).

The design of the license addresses the concerns of all parties likely to have an interest in using OSTP materials. These include the contributors, acting either as individuals or representatives of other organisations such as teaching institutions, distributors of courses based on OSTP materials, and end users of the materials. The license allows elements licensed under the terms of this license to be distributed in packages that contain elements licensed under a closed license, as long as the terms of the closed licensed do not in any way taint the elements licensed under this open license. The license aims to support modification of elements covered by the license whilst at the same time maintaining their quality.

The license covers at least the following:

- *copying, use and redistribution of elements*
- *transfer of rights*
- *modification of elements*
- *general disclaimer (no liability)*
- *storage of elements*
- *charging for distributions*
- *trademarks*
- *linking, transclusion and the relationship of other open or closed works with open OSTP elements*
- *translation*
- *annotation*
- *distribution format*
- *acceptance conditions of the license*
- *third party submissions*

The original author of an element holds the copyright. Organisations may be viewed as the copyright holders for OSTP submitted elements, although in such a case, and where it is possible to do so, the actual author of an element is encouraged to assert their moral right to be recognised as the author of the element[13]*. Rights to use, copy, distribute and modify elements are licensed out by the copyright holder under the terms of this license.*

By accepting this license, you accept all the terms and conditions of this license. Infringing the terms of the license through your dealings with elements covered by it will expose you to prosecution by the copyright holder and/or their agent, which may include the OSTP, under the appropriate copyright laws.

3.7 The OSTP Brand

If the OSTP is to be developed as a brand in its own right, care must be taken in developing an appropriate value statement. Such a statement is likely to include adherence to the open

[13] This right would presumably then have to be waived if the material was open to revision, as it would be under the terms of an open license.

source philosophy as a major defining factor, for example. Along with brand values is the question of an appropriate logo. The OSTP walrus, a cartoon-ish and slightly irreverent device, is in keeping with the 'Linux penguin'; whilst it is likely to appeal to individuals, the willingness of institutions to associate themselves with this device should be borne in mind[14].

4 Constitutional Issues

To date, the OSTP has been managed by a core team of 7 or 8 members from several UK HE institutions. Little effort has been put into deciding constitutional issues, but here again the open source software community is a useful resource to pull on.

From a brief review of the constitutions of various open source software projects[15], it is possible to identify the following areas of that need to be considered:

- Roles, responsibilities[16] and decision making[17];
- project management[18];
- communication[19].

An open question remains as to whether the OSTP constitution should double up for governing the OSTP as an infrastructure project, as well as governing any content-related projects hosted by OSTP, or whether the two should be treated separately. In the first case, the constitution governs decisions relating to the development of the OSTP ideal. In the second case, the constitution covering content-related projects is important because it will determine the way in which material passes through from initial submission to the quality assured resource bank. Since OSTP wants to be in a position to guarantee the quality of materials, mediating the promotion process is important to the whole success of the project.

It is worth noting that decisions made by the infrastructure group may have constitutional consequences for content-related projects. System architecture often imposes certain forms of behaviour on users, and can also be used to force particular behaviours[20]. What this means is that the technical infrastructure can be used to hardwire constitutionally defined procedures. The next major issue that faces the OSTP is to settle on these organisational constitutional issues so that development of the technical infrastructure can proceed in accordance with it (rather than vice versa, in which the infrastructure will end up implicitly defining the constitution).

4.1 Roles, responsibilities and decision making

It is possible to identify several sorts of participant in an open source software project. For example, the java.apache group identify the following sorts of user:

- passive users, who download and use software, but play no other role;
- active users, who don't contribute code but do feedback bug reports, typos etc.;
- developers, who make occasional code submissions;

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[14] This is particularly relevant if the OSTP were to try to push an 'OSTP inside' strategy, especially if this were specified as a term of the license for commercial distributions built largely from OSTP sourced materials.

[15] For typical open source software project constitutions, see, for example, the Java Apache Project (http://java.apache.org/main/constitution.html) or the Debian Project (http://www.debian.org/devel/constitution/)

[16] Roles and responsibilities: see for example - http://xml.apache.org/roles.html

[17] Decision making: see for example - http://xml.apache.org/decisions.html, http://www.debian.org/vote/

[18] Project management: see for example - http://xml.apache.org/management.html

[19] Communication: see for example - http://xml.apache.org/communication.html

[20] See for example, Lawrence Lessig, Code and other laws of cyberspace, Basic Books, 1999.

- active developers, who make significant contributions; active developers are accepted following a vote of other developers;
- passive developers, who were once active, but are no longer involved on a day to day basis.

Different participant types have vary in the extent to which they can influence the decision making processes that go on in a project. Many projects use a voting model to support distributed decision making, and the status of a participant may determine whether that person is allowed to vote, or at what stage they may vote in a decision making process. A vote can typically take one of *three* values, which often are numerical to support automatic calculation of a result:

- *yes* (+1);
- *abstain*, no opinion in some models, further discussion required in others (+/-0);
- *no* (-1).

Vetoes are handled in several ways; where unanimity (or strict consensus) is required, a *no* vote acts as a veto.

In the Debian project, quorate votes require that there must be at least as many votes preferring winning option as the default option (which is typically *further discussion*).

Where votes are taken on several competing solutions to a problem, ranking schemes and transferable votes are often used.

The idea of *lazy approval* is also common, especially for contributions by respected users, in which an item put up for discussion is deemed acceptable unless someone disagrees.

Under some voting schemes, making a *yes* vote means the voter will be prepared to put work into the item being voted on, if the vote is passed. Making a *no* vote sometimes requires a qualification of why the item is not acceptable, especially where that vote is capable of vetoing a decision. The implementation of voting forms (e.g. that have qualification fields that must be completed for *no* votes in decisions requiring unanimity) is one way of architecturally enforcing the constitution, and also demonstrates how the technical infrastructure can also impose constraints that are in fact constitutional matters of concern.

The decision making process of most concern within project initiatives concerns promotion of materials from the initial submission/review area to the quality assured area. The model initially proposed within the project was for a 'subject controller' to take this decision, in a model reminiscent of the way Linus Torvalds has to date controlled promotion of software patches to the Linux kernel. Another approach would be a democratic decision making process, similar to the approach taken in many of the Apache projects; these models offer flexibility when deciding the constituency of voters, and could even support weighted votes depending on the influence/status of each voter. A recent suggestion[21] proposes that there is no official quality assurance as such; rather, content is rated by users who download the material. As well as these user ratings, 'number of download' scores can also be used as a clue to the quality of materials as measured by 'perceived usefulness' - the major difficulty I see with this latter measure is that it allows poor materials to be downloaded often even if they are never used. The implicit contract required with the user in such cases is that they do post ratings scores as a guide to other users.

[21] I hope I do justice to this approach. Contact m.j.weller@open.ac.uk for more details.

4.2 Project management

In the OSTP, there is arguably a need for project management at two levels:

- managing the philosophical and technical underpinnings of the OSTP project;
- managing subject area initiatives that use the OSTP infrastructure to build quality assured content databases.

A similar split exists in the open source software movement, where there are organisations concerned with developing the open source philosophy[22] and providing project management resources[23], as well as a wealth of application directed open source software projects (such as those found on sourceforge).

Part of the remit of the first group is to develop models that will support the second group. The second grouping assumes that within OSTP, content submission will be streamed into particular topic areas (OSTP initiatives) although content will be reusable across initiatives. It is an open issue as to whether initiatives should all conform to an OSTP specified constitution, or whether they will be free to adopt their own[24].

4.3 Communication

There are two areas that are of constitutional concern here: firstly relating to the forums for discussion, project management and decision making; and secondly, concerning the status of documents produced by, and contained within, the OSTP.

In the first category, there are discussion boards or mailing lists that might be associated with each of the participant types, or may have ranges of privileges associated with them (e.g. differential write permissions, or vote weightings, depending on participant status).

In the second category are the various document types and the statuses that may be associated with those documents. For example, there are likely to be documents associated with the OSTP itself (such as the constitution and the license) as well as 'content' documents that are submitted to the project. It is intended that infrastructure development will be handled as an open source software project in its own right (though whether this will be managed separately is another issue). Each document type will have a range of associated statuses such as draft, under review, under vote, etc.

Identifying document types and statuses is useful if constitutional limitations on how those documents can be used, or who can change them, are to be handled automatically by the technical infrastructure. For example, elevating the status of a document form 'working document' to 'under vote' may freeze the document, automatically create a poll or vote and notify relevant project participants.

5 Infrastructure

In this section, I shall outline the technical infrastructure (using a centralised model) required to host the OSTP. The OSTP infrastructure will essentially provide an online, collaborative working environment. Technical requirements fall broadly under two headings: a) discussion environments; b) content management systems. Note that these two systems are not necessarily discrete, as for example in the central case of managing submission reviews,

[22] For example: http://www.opensource.org
[23] For example: http://www.sourceforge.net
[24] For example, there are several 'official' projects working under the Apache umbrella, but they have different constitutions.

where the discussion will revolve around submitted content[25]. Some distributors may have a further requirement, specifically some sort of course building environment. However, that is of little concern to us here (the OSTP is involved in the step *before* distribution assembly) except that the output of the OSTP system should be usable in course building systems.

5.1 Discussion environments

To date, OSTP has relied on face to face project meetings, personal email, a project mailing list, a prototype website and, most recently, a bulletin board. Formal document types and statuses have not been used as yet to manage project resources.

Traffic on the mailing list has tended to be one way and provoked little discussion on the list. The best medium for discussion to date has been face to face meetings. The project group are currently evaluating the YABB bulletin board (an open source piece of software, written in Perl, in which threading is handled by directory structuring and messages are stored as files within thread directories). As yet there is no definite commitment to a particular discussion environment. FirstClass has not been used, the intention being that the whole of the project infrastructure is supported using open source software.

5.2 The content management system: overview

At the heart of the OSTP technical infrastructure will be a content management system that should be capable of supporting:

- document upload, review and promotion to a quality controlled area;
- metadata management;
- browsing and searching of content, automatically identifying relationships between component submissions;
- citation management.

The two broadest technical issues that confront OSTP as regards developing the content management system are:

- site design;
- database design.

At present, the OSTP project team are still at the pathfinder stage of identifying the content management system design. A prototype system is currently under development, using mysql (as the backend database) and php[26]. Database records will cover at least user registration, user affiliation, content markup, citation management and session tracking. A mockup of the sorts of interfaces that will be provided by the prototype system is available from: http://www.opensourceteaching.org/protosite/overview

There has been considerable debate about the level of granularity of submissions, and the way submissions should be marked up to support reuse. The protosite overview contains details regarding the submission process for single and bundled documents. Considerable effort has been put into identifying the appropriate metadata scheme, as will be described below.

An as yet unconsidered question the extent to which 'course structure' submissions should be accepted (for example, as XLink heavy documents that transclude information from OSTP

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[25] For example, environments such as D3E provide support for the threaded annotation of online documents.

[26] The system is only occasionally available online. Contact the author for more details, or a daily snapshot of the source code/database table structure.

assured material). It is the intention that users who download bundles of material implicitly make a 'bundle structure' submission to the OSTP, so that user identified relationships can be used to aid component selection (for example, '87% of users who selected that object also chose this other one'). The potential this latter approach has for creating 'self-organising' distributions, in a similar way to the automated 'component crystallisation' model described in section 6.4 below, are potentially rich research areas in the knowledge media domain in their own right.

Progress of document flow through the OSTP must be carefully considered and version control is potentially a problem. Ideally, users will be able to check out content and improve upon it. The original document will remain in the system, but qualified with a tag that denotes it has been superseded. A history of changes will be maintained in which all user contributions, of whatever sort, are logged.

5.3 The content management system: metadata and restricted vocabularies

Metadata is a key issue, since it supports the accurate identification and extraction of submissions from the database. Without metadata to describe submissions, the submissions will be all but worthless if any degree of structured searching is required.

There are several metadata initiatives relating to the markup of educational materials, and the OSTP has considered two in some detail: Dublin Core[27] (+ educational extensions, which I shall term DC+E) and the IMS metadata scheme[28].

Two major requirements of the OSTP metadata solution are that:

- it is compatible with other standards (IMS, DC+E in particular);
- it supports the full range of functionality required by the content management system.

The current feeling is that the OSTP metadata scheme will comprise a subset of the IMS scheme, with additional fields to support citation management, amongst other things[29].

Associated with the idea of metadata, is the definition of an OSTP restricted vocabulary for populating metadata fields. Restricted vocabularies offer several advantages, not least because they:

- support metadata entry by form-filling from listboxes and menus; and
- facilitate searching (especially if the vocabulary conforms to other standardised restricted vocabularies);
- if the semantics are clear, they also support the accurate markup of content.

Librarians and information science professionals have significant expertise at marking up and classifying documents. Institutions who allocate this sort of resource to the OSTP will be seen as making a contribution of the same value as institutions who make content submissions.

5.4. The content management system: citation maintenance

One of the aims of OSTP is to help raise the status of educators who produce high quality teaching materials[30]. In the academic research area, progression is often predicated on the number and quality of research publications. One aim of OSTP is facilitate a similar model

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[27] http://dublincore.org/
[28] http://imsproject.org/
[29] Contact Nick Meara, n.i.meara@open.ac.uk, for more information on the OSTP metadata scheme.
[30] Contact Tony Nixon, t.p.nixon@open.ac.uk, for more information on OSTP citation management.

for teaching academics. Citations in particular are one way of rating the quality and usefulness of publications, and two models are proposed here, one formal, one informal.

The first (formal) model requires distributors to inform OSTP about OSTP sourced content used in a particular distribution (such as a particular course). In a commercial setting, this sort of tracking would be used to allocate royalties; in OSTP, however, the aim is to produce a citation list so the extent to which a piece of material has been used can be tracked. Ideally, this information could be used to support applications to the ILT for professional membership, for example.

The second (informal) model allows users who have downloaded material to rate its usefulness to them in a particular context, such as delivery medium, and may also be identified on the basis of the frequency of user downloads, and the correlation between materials downloaded at the same time. This sort of rating scheme is similar to the one offered by Amazon, for example, which allows users to rate books they have read.

Both models are additionally capable of supporting users looking for materials in the OSTP databases.

5.5 The content management system: constitutional side effects

As has been mentioned previously, decisions made by the infrastructure group may affect OSTP initiatives through architectural constraints. That is, it is possible that any technical infrastructure decisions will have constitutional side effects at the initiative level. For example, should the site require users to register themselves before they can upload or download material? What amount of personal data is required for registering users (at the moment, we store name, email and affiliation)? How will decision making be implemented; for example, will it rely on OSTP managed polls?

5.6 Reconciling the discussion environment with the content management system

At the moment, there has been little thought on the best way of handling comments on submitted materials. Ideally, the discussion environment and content management system will be interoperable. A php version of the YABB bulletin board is under development by the open source community, using a mysql backend database. This database solution is likely to be more flexible than the directory based solution offered by the current version of YABB, and will also be more easily integrated with the prototype mysql/php content management system.

An already developed solution to providing commenting facilities for documents is the open source document discourse environment[31] (D3E). D3E provides an online environment for asynchronous commentary on hypertext documents, and also includes a facility for segmenting large linear html documents, e.g. so that individual section can have their own html page. Potentially, this functionality could be used to automatically reduce chunk size of submitted documents, for example by decomposing lengthy submissions into individual chapters or sections. D3E is customisable, and provides one possible medium for commenting on submitted content.

5.7 Managing quality

In the original model, a 'gatekeeper' was assigned to sit between the content submission area (the depository) and the learning object resource bank. This gatekeeper would then promote material to the resource bank when a) it had been deemed as being of acceptable quality by a group of peer reviewers; and b) suitably marked up with metadata. An alternative model, in

[31] http://d3e.open.ac.uk

which users simply rate materials as they come acroos them, has also been proposed. It may be that if different OSTP initiatives have different constitutions, different QA processes will be put in place.

5.8 A distributed OSTP model

One possible distributed architecture resembles the Napster peer-to-peer file sharing approach. Individuals manage their own OSTP client, which is a database of LOs stored on each individual's machine. Logging into the OSTP network registers the LOs available from each client. Modified LOs would be tagged with the LO from which they were derived so that an audit trail can be used to track the developmental history of a particular LO, identify whether a particular LO has been revised etc. Downloads of an LO from each client would be logged and this information then made available to the network. Users wishing to upload content would do so using their own OSTP client. In effect, the client would replicate many of the content management services provided in the centralised OSTP model. All uploads would recieve a unique ID number, potentially incorporating the users OSTP login ID. A permanently logged in universal client would make a copy of all submissions and act as an archive of all submitted material. Because users were storing LOs themselves, the intended effect would be that users would retain LOs they found useful and delete (from their machine) LOs they did not favour. If user subject areas formed part of each users' profile, the density of LOs across users interested in a particular area could be seen as an indicator of the usefulness, or importance, of the LO. (This is an approach that resembles search engines which use the number of links to a page to identify the usefulness of the page.) This architecture would potentially appeal to individuals, since it involves them to a far greater extent than a model which requires them to log into a single monolithic OSTP site.

Organisations submitting content may make the content available through a 'corporate client'. Individuals working for the organisation may then connect to the OSTP network through their own dummy client which in turn is connected to the corporate client. In this way, accreditation of content to both author and their employer can be logged. (Essentially, an OSTP-like intranet would exist, itself connected to the global OSTP network; however, this model also allows organisations to run OSTP-like content production and management models within their own organisation, or as part of a closed extranet with consortium partners, without necessarily connecting to the open, global network).

Citation management can also be handled using a networked approach, with distributors required to publish references to OSTP materials they have used to an OSTP-citation network. Here, the burden is placed on the distributor (under licensing conditions) to maintain a publicly and permanently viewable list of citations (in contrast, individuals logging into the OSTP-content network need not be permanently connected). These lists can then be farmed to build up comprehensive commercial citation lists.

It may be that a two tiered approach is appropriate - for example a lower tier P2P submission and revision area, and a centralised database that cherry picks from the P2P network and effectively kitemarks selected LOs.

5.9 Motivating individual contributions

Motivating users to submit content and use content to produce distributions are the two challenges faced by OSTP on the content front. I have already discussed licensing issues, and how the license must be acceptable to users, here I consider practical ways of encouraging participation.

As far as content submission goes, the citation index is one of way of encouraging participation. The major problem lies in providing a context in which users feel they can make a contribution. There has been much debate in OSTP regarding whether the OSTP should

simply host all manner of standalone components, or whether it should focus on soliciting content for particular courses. A halfway house is suggested by the idea of topic initiatives, which provide the context of a topic area for submissions, from which components can be pulled to build particular courses in that area.

Evidence from the open source software community suggests that users are most likely to participate in a project if they feel they are either initiating something that others will find useful, improving a component, or helping complete some project.

Initiators will start initiatives and potentially act as project manager for the duration of the initiative.

Improvers will play a role in reviewing and editing submissions, for example.

Completers can potentially contribute at two levels: firstly, at the learning object level, for example by providing self-assessment material to supplement a piece of teaching material, or adding metadata to a learning object record; secondly, we might assume that within each topic initiative is an OSTP sample course distribution. This course would provide a skeleton to help identify where content was lacking in the initiative[32]. Users would still be free to make topic related submissions to the initiative that did not necessarily flesh out the skeleton, but would be useful for other courses in the topic area. The distinction is subtle, but important: OSTP is not about collating materials for release as particular course distributions, but is about providing a set of resources that can be used to build courses. Providing one or more sample course distributions in an initiative is simply a device to help users identify where they can make a useful content contribution to that initiative.

Finally, it is worth noting that the user interfaces to OSTP should be usable by novice computer users. Unlike open source software projects, where participants are likely to be sophisticated computer users, the OSTP cannot assume that educators who can produce good quality educational material are also knowledgeable computer users.

5.10 Motivating institutional participation

In the first case, this is likely to require a demonstration of a sound business model for a potential distributor. Pressure may additionally be applied from the ground up by academics themselves. Recognition of the author citation model by the ILT, for example, would also be a positive factor (and may also gain further credibility for the ILT). In the longer term, if the standing of academic authors were to be more widely recognised, there could be an argument to be made in favour of novel funding arrangements, e.g. in which professional institutions awarded 'writing grants' (rather than research grants) for the production of materials that were to be submitted to the OSTP[33].

For distribution builders, interest is likely to be motivated by commercial gain. In sections 7 and 8 I discuss some of the commercial opportunities that will arise off the back of OSTP, as well as consider the benefits of resource gearing that the OSTP model provides.

5.11 Delivering material to distributors and other users

The output of bundled content from OSTP should be compatible with course building packages that distributors are likely to use. This computability issue has not as yet been

[32] This sort of model ultimately leads to a course building application. The OSTP does not intend to go this far, but an interesting question remains as to the extent to which the material selection model must support at least some minimal course building facility.

[33] cf. also the practise of academics who use research grants to 'buy themselves out' of teaching time. The same could be done to 'buy' writing time by institutions who wouldn't normally support such an activity to the extent required to produce high quality materials.

addressed, although a lazy decision has been taken to conform to the IMS content packaging specification for delivery of materials from the OSTP database.

Another useful download support tool would be an outliner that allows a user to create a course outline using OSTP recognised keywords or controlled vocabulary terms. The system could then identify and suggest available LOs that may be appropriate for each section in the outline.

5.12 User scenarios

Several user scenarios have already been identified:

- single academic author submitting personally generated content (single item or many items, including complete course);
- single academic author submitting content developed for use at their place of employment;
- multiple authors submitting personally generated content;
- multiple authors from the same organisation submitting content developed by them at their place of work;
- heterogenous multi-author submissions (e.g. unaffiliated author, authors with different affiliations);
- corporate submission of content;
- third party submissions (i.e. submitter is not one of the copyright holders);
- metadata submission by information science professional;
- metadata submission by mark-up novice;
- download of single or multiple items by individual teacher;
- download of material by independent student;
- download of material by distributor.

Developing user models/protocols for each of these scenarios will give a clearer view of the sorts of interface required.

6 Content Building Blocks

In this section, I will look at the broad issue of content reuse, identify those aspects of particular relevance to OSTP, then go on to consider one possible structural form of a reusable learning object.

6.1 Why do we need reusable components?

In the Open University, the CURVE (Course Reuse and Versioning) project was set up to consider reusability and versioning issues as they relate to OU teaching materials[34]. The project team produced a set guidelines and case studies that are quite relevant to the OSTP.

The use models identified within the CURVE framework were:

- updating;
- reshaping (structural changes);
- resizing;
- transnational repurposing;
- sectoral repurposing;
- cross-media redesign;
- framework repurposing (for inclusion of local content);
- generic and level adaptation;
- preversioning.

[34] http://iet.open.ac.uk/curve/

Submissions to OSTP will to a large extent be concerned with last of these, preversioning - "design of course and course materials, in a manner which allows them to be easily remade and versioned" - although many of the other models are also relevant, particularly updating, where legacy content is donated to the OSTP. According to CURVE, preversioning requires that work is "sectioned into reasonably small, topic based reading and activities", a model we have implicitly been adhering to throughout.

CURVE guidelines also suggest that at a coarser level of granularity, specifically modular courses, there should be:

- minimum cross-referencing between items;
- unidirectional cross-referencing from supplementary material to main text;
- separation of long and short life materials;
- use of separate glossaries.

These guidelines are also relevant to OSTP submitted materials. One of the major tasks of OSTP is to produce its own guidelines on the most effective structure for submitted items in the OSTP context.

6.2 Reusable components in OSTP

Arguably the architectural aim of the OSTP technical infrastructure is to develop the bottom layer of a 'repurposing framework', in which the top layer is the branding of a distribution by a particular distributor. Arguably, submissions to the OSTP may be of two kinds:

- learning resources;
- learning objects.

Learning resources are simple content submissions, such as text documents, figures, applets, etc, used to deliver information, or provide standalone exercises; SAQs may as be classed as learning resources. A *learning object* is an organisational structure that combines learnig resources in a particular way, as I shall discuss below.

6.3 Learning classes and learning objects

There has been much discussion in the wider community about the notion of a learning object, and this remains a major research within OSTP and elsewhere. The view of a learning object I put forward here is architecturally motivated, and comes from a consideration of building automated tools to support object selection according to a set of given user criteria.

In the computing field, an object is an instantiated class, where a class defines at least a logical structure and object instantiations of the class conform to that structure. The challenge that faces us is thus to define a *learning class*, such that instances of this class are sensible looking *learning objects*. I mentioned that this design is motivated by architectural considerations; in particular, the design should:

a) include containers for teaching material;
b) support a way of identifying what a particular object is supposed to deliver;
c) provide a way of checking that that delivery has been successful;
d) support user selection of material for inclusion in a particular distribution.

The design should also reflect a model of learning. The model I shall assume here is cognitively based and requires that: a learning object is an instance of a learning class that is capable of converting a (set of) learning objective(s) to a (set of) learning outcome(s) through

the delivery of teaching material; (self-)assessment material checks that the conversion has been achieved.

Learning Class:

Requires: *previously achieved learning outcomes (which may include key skills attainment)*
Identifies: *learning objectives*
Contains: *a) teaching material (may include documents, exercises, audio-visual materials etc.)*
b) (self-) assessment material
Delivers: *learning outcomes*

One thing to note here is that a certain amount of metadata about the teaching material has been made explicit within the learning class that wraps it. For example, a user submitting a code fragment to a computing initiative will be asked to provide learning objective information as part of the metadata input that wraps the content submission, but this metadata is explicitly stated in a learning object.

We might also note that the *Contains:* component actually defines a 'method', or 'function', specifically, one that implements the conversion of learning objectives *and previously achieved learning outcomes* to a new set of learning outcomes[35].

It is worth noting that a learning object may itself contain one or more learning objects. For example, a learning object at the level of a chapter may contain learning objects at a section level, and these may in turn contain subsection level learning objects. No matter what level of granularity material is submitted at, if it is capable of satisfying the conditions of a learning object then it should be in principle acceptable to the project.

Finally, it may prove useful to distinguish between unordered bundles, or collections, of LOs that are submitted to, or downloaded from the OSTP, and structured collections, such as a submitted course that can be recursively decomposed into LOs of ever finer granularity. In

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[35] The view of learning objects presented here in some way resembles that of the Reusable Learning Object (RLO) specification developed by Cisco Systems (http://www.cisco.com/warp/public/10/wwtraining/elearning/learn/whitepaper_docs/rlo_strategy_v3-1.pdf). The RLO is a container for 5 +/- 2 content delivering reusable information objects (RIOs), wrapped by an overview and a summary, and containing pre- and post-assessment material for each RIO. Each RIO contains content, practise and assessment items, though the latter are moved from the RIO when it is placed in an RLO container, to the RLO assessment container. In terms of OU material, an RLO corresponds to a study guide chapter, for example; and each RIO corresponds to the material that delivers a particular learning objective within the chapter.

The RLO-RIO structure is seen as being embedded in a hierarchy such as curriculum, unit, module, RLO, RIO. This contrasts with the view of the Learning Class, which may be recursively defined as a container of other Learning Classes; (in the RLO framework, this would presumably correspond to an RLO that is also used as a RIO).

The RLO overview must contain an introduction, a statement regarding the importance (use value) of the RLO, a list of learning objectives (one per RIO), prerequisites for taking the RLO e.g. in terms of other RLOs; and an automatically generated outline/contents list of the RLO. The RLO summary reviews the RLO, and each RIO in it, and optionally identifies other RLOs or additional resources related to the subject covered by the RLO.

Although the assessment material is a separate and identifiable part of an RLO, the material is actually created as part of each member RIO. Each RIO is intended to deliver a single learning outcome, and provides content (teaching materials) and practise materials to reinforce the content. The assessment material is used to check that the learning outcome corresponding to the RIO's learning objective has been attained by the student. Ideally, each RIO should contain a pool of assessment items from which one or more can be used as part of the RLO assessment.

order to do this, the *Contains* field of Learning Class should support either ordered or unordered collections of material.

6.4 'Component crystallisation'

By suitably marking up learning objects in terms of the learning outcomes that they require/deliver, a user should be able to query a suitably populated database with a set of 'entry point' learning outcomes and required learning objectives/outcomes and allow the system to come up with a set of connected learning objects that deliver the learning outcomes from the stated initial conditions. This 'component crystallisation' model for automatically constructing courses based on available resources is a topic of research in its own right.

7 Open Education Business Models

This section is a brief working of Raymond's Magic Cauldron, which describes several open source software industry business models.

7.1 HE Involvement with OSTP

Why should an HE institution involve itself in OSTP? There are two main reasons:

- *cost-sharing*: to develop a large course requires considerable expertise and expense; by sharing the development costs of course material with other providers, the development time is reduced and the course is quicker to market.
- *risk-sharing*: if a course team has one or two key authors who defect to another institution, the course is still maintainable by the wider developer community.

7.2 Open source education business models

Although open source education is an as yet unproven idea[36], it is possible to see how several successful business models from the open source software world[37] could be used in the education marketplace:

- *sell bindings*: the O'Reilly take on open documentation;
- *selling syllabuses*: give the content away, but sell the students a pathway through it;
- *examination and assessment* (selling degrees): give the content away, but let the student pay for the assessment; one of the OU's CURVE project guidelines suggests that the "assignment strategy [should be used] as the framework which encourages students to reflect on the links between different areas in the modules they have taken."; this is therefore one way of adding educational value, as well as providing assessment services;
- *accreditation*: accredit the material produced by others, even material submitted to OSTP;
- sell the material in the short term, but open it up when it expires (so e.g. alumni can still find support);
- sell tutor support;
- *educational leisure products/edutainment*: developing educational wrappers for consumer items (popular science books, museum visits, 'toys' such as robot development kits, software packages); developing and opening this material up means it can be used as a taster for either selling complete, branded versions of the same material, or pulling people into full courses;
- sell the walrus...(mugs, T-shirts, mousemats etc.)

Relating these models to the learning object discussion in the previous section, we can argue that an educational institution's intellectual property (as regards teaching) is therefore not

[36] This is not strictly true. For example, O'Reilly commercially publish documentation products originally released under open documentation licenses.
[37] See for example: http://www.tuxedo.org/~esr/writings/

simply contained in its teaching material. Rather, the IP is contained in how it manages to convert a set of learning objectives to a set of learning outcomes in the student. One might think of the teaching materials providing a set of resources that may be used within learning objects, but those materials in and of themselves do not necessarily comprise learning objects. Just submitting a set of lecture notes as a resource to the OSTP is potentially only the first step in the road to inclusion in the learning object resource bank.

7.3 Example distributions

As a proving ground, OSTP members have been involved in the development of a teaching material suitable for a course in Visual Basic. These prototype OSTP submissions will be used to create two very different distributions - one for web-delivery, with OU branding[38], the other for face-to-face computer lab delivery, with University of Ulster branding[39].

Reverse engineering of existing courses is one way of bootstrapping the whole OSTP process. This approach is also appropriate if an institution has a pre-existing course that has come to the end of its presentational, though not necessarily useful, life and that can be opened up so that it can be maintained by the community as a whole. The reverse engineering process would involve the stripping away of branding, and possibly navigational components, and splitting the course up into smaller, reusable components.

7.4 The UK e-University: a way forward?

The UK's e-University initiative posits the HE community developing materials collaboratively for the delivery via the web. IPR issues have dogged progress on developing the e-University model, but the OSTP approach provides a possible way forward[40].

There have been many great claims for the use of new media (such as the world wide web) in course production and delivery. Many of them are related to whether the production and delivery of web-based material is quicker or cheaper than print material. *Arguably, there is little reason to believe either.* In the publishing world, the cost of actually printing a book is very small compared to the costs of authoring, editing, design and marketing. The cost to the customer - who may well print out a large amount of electronically delivered material - may indeed be increased if their printing cost exceeds that of the unit cost to the publisher who prints several hundred copies of the material. Frequently, the publisher must make a 'printer friendly' copy of the electronic material available, which adds at least to the design and edit time, if not requiring additional author time as well (though technologies such as XML will reduce the amount of work required to produce different versions of he same document).

The OSTP offers one possible model for sourcing the content that will be delivered by the e-university players. Essentially, the e-University will take on the role of a distributor of OSTP sourced materials.

By submitting content under an open license to the OSTP, the HE community as a whole can then:

a) fulfil a commitment to providing resources for the e-University; whilst
b) exploiting that material as a distributor either on their own or as part of a consortium.

In addition, individual universities would be free to provide additional added value services as described above. What the OSTP model does is introduce a middle tier between HE institutions and distributors, such as the e-university. As well as decoupling institutions and

[38] Email i.j.stevenson@open.ac.uk for more information, or see the OSTP website
[39] Email ij.mccrum@ulst.ac.uk for more information, or see the OSTP website
[40] See also Appendix - The Proposed e-University, and Appendix - Annotated OU Response to the e-University Proposal.

the e-University, the OSTP model also provides a framework for producing quality assured, maintained material in a distributed way.

NB OSTP is not limited solely to the development of web based educational materials. The intention is that materials should be reusable (or appropriate for repurposing) irrespective of the mode of delivery.

There are many opportunities for strategic alliances with other research projects. For example, organisations with a large back-catalogue of content in no longer supported electronic formats would benefit from an OSTP tie-in with a 'data-archaeology' project responsible for converting documents into useable formats. The pay-off for the organisation in this case is that the content becomes useable once again.

7.5 OSTP for course maintenance

Organisations such as the OU both manufacture (i.e. publish) educational materials and offer a range of services that support the exploitation of those materials. It is worth noting that aside from the open aims of OSTP, the content management system and community developer model may be applicable within single institutions, or across consortia, for producing content, either open or closed.

In the context of the OU, the OSTP will provide a database of materials that could be used to rapidly prototype a D1 of course, or provide proof of concept for a proposed new course.

In The Magic Cauldron, Raymond says (p4): "Most ... in-house code is integrated with its environment in ways that make reusing or copying it very difficult...Thus, as the environment changes, there is a lot of work continually needed to keep the software in step. This is called 'maintenance', and any software engineer or systems analyst will tell you that it makes up the vast majority...of what programmers get paid to do." As far as the OU is concerned, it could be argued that material produced for specific courses is tightly integrated within those courses. Even if a course is replaced by one that covers at least some of the same content, there is the tendency *not* to reuse the previously produced material, notwithstanding initiatives such as CURVE which aim to maximise reuse. As with commercial software[41], when an OU course expires, the demand for its content (e.g. study guides) falls, which suggests that the students are primarily purchasing added value over and above a well structured path through a particular topic area (as provided by a single course, for example).

Maintenance is potentially a problem where courses are delivered in several regions, particularly if the final year of presentation varies across those regions. By taking the material open, the burden of regional repurposing can potentially be farmed out to educators working in those regions.

Maintenance, in the OU course team (CT) sense, has in the past focussed:

- on keeping courses in production through the creation and reuse of assessment material (and associated tutor notes);
- servicing the course through: i) Examination Boards, and ii) tutor monitoring.

However, with the increasing use of First Class conferencing, CT members are becoming more involved in delivery of courses through their participation in conferences. In personal time budgets, these activities are likely to be classed as maintenance. (NB assistant lecturers

[41] Raymond, Magic Cauldron, p5: "...when a software product's vendor goes out of business (or if the product is merely discontinued), the maximum price the consumers will pay for it rapidly goes near to zero regardless of its theoretical use value or the development cost of a functional equivalent....the price a consumer will pay is effectively capped by the *expected future value of vendor service*..."

who tutor courses may be considered either as involved in delivery of materials (CT perspective), or as maintaining the course at the regional level).

By opening course material up, some of the maintenance burden can be passed on to the user community. With current OU materials, a) students often identify 'bugs'; b) ALs often come up with improvements to the teaching material that cannot be exploited. The OSTP model offers a way of harnessing both these resources (student feedback and AL content submission). In addition, the distributed working model potentially offers a significant lead in time for new courses, even if OSTP sourced material is only used for rapidly prototyping first drafts of new courses.

7.6 Resourcing the OSTP

Several sorts of resources are required if the OSTP is to prove successful; along with content and metadata submissions (author and information scientist resources), technical support and hardware resources will be required to develop and maintain the technical infrastructure.

The OSTP is likely to be able to spin-off many services and applications; for example, tools and training for supporting the OSTP metadata scheme and Learning Object structure; customisation of the content and citation management systems, training and technical support for institutions wishing to employ OSTP-like processes themselves; IPR and copyright advice. Obtaining funding through 'author grants' is also a long term aim.

8 Other open source education repositories

There are many open source education initiatives already on the web, and in this section I shall briefly review some of them. Note that this list is not complete, but it does demonstrate the range of infrastructures and content already available.

8.1 Educational Object Economy (EOE, http://eoe.org/)

The Educational Object Economy has a similar aim to OSTP in providing a database of reusable educational materials. Users can write reviews of submissions, make technical suggestions about the content, and add metadata to wrap submissions. However, there is no mechanism for supporting incremental improvement of submissions, or promoting material to a quality assured area, nor is there any notion of citation management.

8.2 Multimedia Educational Resource for Learning and Online Teaching (MERLOT, http://merlot.org/)

MERLOT resembles OSTP in that is provides a database of searchable educational resources submitted by community practitioners. Registered users can upload material, and browse and download material hosted by the project. Submitted materials are peer-reviewed by MERLOT members[42].

8.3 National Online Learning Community Initiative (NOLCI)

This project builds on the EOE infrastructure to provide a 'collection of peer-reviewed, student-tested, and competency-based learning applications that can be accessed by faculty and students via the world wide web'.

8.4 Gateway to Educational Materials (http://geminfo.org/)

This project offers a distributed gateway approach by storing links to material hosted on other machines. Quality checks are in place that allow promotion of links to a quality assured area.

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[42] See for example: http://taste.merlot.org/process.html

However, by not hosting the content centrally, the project has no guarantee that content linked to is stable.

8.5 MIT OpenCourseWare (http://web.mit.edu/newsoffice/nr/2001/ocw.html)

The recently announced MIT OpenCourseWare was the subject of much comment worldwide, not because it was the first time educational content was being made freely available *per se*, but because it is the first time an leading educational institution has committed to an open license project in such a major way. The MIT initiative is to make their course materials available freely on the web.

8.6 ROUTES (http://routes.open.ac.uk)

ROUTES is a library initiative to identify authoritative web resources for particular topic areas. ROUTES does not support collaborative development of materials, or necessarily identify openly licensed resources.

8.7 SOURCE (http://source.open.ac.uk)

A UK HE community project involved in the development of open source educational software.

8.8 Where OSTP differs

The OSTP is not the only project involved in supporting open source education, but is arguably the only that supports: a) a learning object (as opposed to learning resource) focus; b) a licensing framework that supports use and modification of materials; c) community development, improvement and peer review of submitted materials.

There are many initiatives in which course material has been made available on the web, but these have tended to meet with little success either because the materials themselves were not learning objects, or because business models for exploiting the materials had either not been identified, or were legally unfeasible.

We might ask ourselves why there appear to be no huge successes on the scale on open source software (the MIT initiative raised a lot of press interest, but its success is yet to be demonstrated). One reason may be the difficulty associated with locating (and guaranteeing) high quality materials; another has to do with asking why anyone should contribute (the OSTP citation model offers one possible solution to this). A third is that there isn't such a need in the educational market to come up with a free alternative to a single, dominant, commercial system. In UK HE, there is divergence in terms of available courses and degrees because there are no set national curricula. For school education, however, where there are National Curricula, it may make sense to provide a stock of educational materials, available to all, yet still customisable both in terms of adding new content, and also in terms of how to present the core content.

In the initiatives identified above, the user model is not always clearly identified, for example in terms of licensing issues, and it is hard to see how institutional backing can be encouraged. If such backing is not forthcoming, it is unlikely that the OSTP approach will achieve the market recognition it will need if it is to become self-sustaining. However, with the backing of major educational brands (such as the Open University, or the old Universities) the OSTP could very quickly achieve a high level of recognition in the short term, as the MIT announcement demonstrated. In this case, the OSTP would have to rapidly demonstrate its usefulness in getting a distribution to market via some third party making use of OSTP sourced materials, otherwise the OSTP initiative would go the same way as many of its precursors, at least in terms of its adoption by institutions. Another approach is to go for organic growth, through individual submissions and use. However, this model is more in

keeping with previous ventures (or a distributed model?), and as such, it is open to doubt as to whether such an approach can ever achieve significant and widespread success.

Another likely reason stems from the differences between open source software, and open content. In particular, software either: a) works or it doesn't (and then may be seen as being efficient or inefficient, easy /hard to maintain/extend); b) is feature rich or feature poor according to the requirements of the user. In addition, open source software has tended to follow an evolutionary model. Since the time of Darwin, evolutionary models have presupposed the existence of life (i.e. a working program, or a prototype distribution), with the evolutionary process then serving to adapt the thing in the context of its environment. In the more general content arena, the sense of closure (e.g. as afforded by a working program) is hard to identify; however, the LO framework attempts to provide some feeling of closure to individual content submissions.

Appendix - The Proposed e-University

Notes for the OSTP on HEFCE document 44/00

Numbers in brackets correspond to paragraph numbers in that document. [AN:X] refers to Annex N, paragraph X.

The eU is intended as a vehicle for education delivery [A3:34] that lies somewhere between a complete, award making virtual university [A3:10-12] and an application service provider providing tools and support services for such an organisation [A3:13]. Frontline activities will include the provision of courseware to students, and production tools and services to developers [3:64]. The eU concept is intended to facilitate new ways of thinking in UK HE, particularly with respect to the development and delivery of educational materials and pedagogy using emerging technologies [18]. The eU will most likely be owned through a UK-HE holding company [126], although it will be developed as a strong brand in its own right [123, 222] to the extent that an 'eU inside' marketing strategy (based on the 'Intel inside' strategy pursued by chipmaker, Intel) has been suggested [228]. The holding company would be charged with developing the eU brand and managing the eU technology; the eU itself would be responsible for charging, collecting and allocating fees [142]. In its set up phase, the eU partner organisations would be expected to contribute resource, until revenue streams came online [222].

In contrast, the OSTP encourages a novel production methodology, and a novel socio-economic model for the educational arena and will potentially be organised as a charitable, educational foundation.

The eU will be learner driven [20], responsive to change [21], and offer an excellent fit to purpose [21]. The OSTP model allows for a broad coverage of subjects, a potentially huge resource availability, and supports customisation of material into new markets by small and medium sized organisations [A3:39]. The value adding distributor model will encourage novelty and high standards of service, as distributors establish their own brand values.

The eU will act as a facilitator, and will not award its own qualifications in the first instance [29]. Some providers may provide additional tutor support to enhance the delivery of eU materials [31]. As the OSTP has already identified, offering qualifications, accreditation services and tutor support are good examples of value added services.

Universities will be encouraged to convert existing courses to electronic delivery formats, for use within the eU context [33]. In a similar way, we hope that institutions will donate content to the OSTP. The granularity of submissions to the eU is expected to change over time, starting with course level submission and ultimately leading to ever finer grained submissions [A3:53]. XML as the main submission medium is anticipated [A3:55]. In addition rich metadata descriptions will be required for all submissions [A3:56], using standardised metadata formats [A3:58]. The structure of eU courses should reflect current taxonomies [A3:57].

The eU content database will offer a *navigator* interface to help students pick modules [37, 38]. The OSTP has identified the user interface, and in particular it universal appropriateness, as being a major work area. The navigator will help students choose modules where necessary [102]. It will be paid for by the people who use it [107].

The database will itself act as a learning object repository [59], with all materials being quality assured by the eU [62], as overseen by a committee charged with guaranteeing the academic excellence of all materials [63]. The actual review of materials could be handled by

peer review in a similar way to the Research Assessment Exercise [66]. That a new model of quality assurance for online teaching materials is needed is recognised by the eU, and it has been suggested that a quality management process should drive production of materials [65]. To this end, guidelines for producing materials will be made available, covering such issues as instructional design, best practise, formative and summative assessment, quality assurance processes, and interoperability compliance [A3:42]; adherence to these guidelines would be facilitated by the provision of official templates [A3:43].

The eU suggests making materials available using variable fees models [40, 184]. Although the OSTP will not charge fees for use of the content donated to it, different license agreements may be necessary to place different obligations on different classes of user (for example, commercial distributors would have to make appropriate citations).

Several potential revenue streams for the eU have been identified [172]:

- learner fees;
- design tools (e.g. LO templates);
- communication services (e.g. by acting as an ISP);
- content management services;
- merchandising, advertising and reselling of customer data.

Revenues would be allocated according to [177]:

- content ownership;
- provision of learning support;
- provision of the technology platform;
- provision of navigation services;
- provision of award presentation.

Several added value services providers may use to customise their own offerings have been identified [A3:85]:

- tutorial support;
- assessment, schedules;
- library services;
- peer group interaction, CMC;
- learner record management.

The various models available for assigning content ownership (sole eU ownership, sole provider ownership, shared eU/provider ownership [A3:77]) are likely to severely complicate royalty allocation, content management, and metadata maintenance, for example [182, A3:73]. Indeed, the whole area of IPR has been identified as a major area of concern for the eU [183, A3:15]; furthermore, the move towards digital publication of materials has forced HEs to consider their IPR management, so they may exploit the value of the content they own.

The eU would be responsible for commissioning materials [41b], quality assurance [41c], and eU technological infrastructure [41d]. The starting point for the eU would be making use of whatever materials are currently available [42]; however, it is recognised that content development often relies on enthusiastic individuals creating the material [A3:38]. The OSTP faces a similar challenge in encouraging institutions to open up their content.

The eU makes a distinction between the smallest unit of study and the smallest unit of production [51]. Typically, eU modules should be self-standing, offer interactive tutorial support, self-assessment, practise opportunities and be externally assessable [52-55].

Three sources of content have been identified as follows [68]:

- externally procured by the eU (in which case copyright is held by the eU);
- provided as the result of joint investment by the eU and an external content provider (shared copyright);
- developed by an external provider (in which case, copyright is held solely by that provider).

Content suppliers are anticipated to range from [A3:66]:

- private training companies;
- HE institutions;
- media companies;
- SMEs;
- public content repositories;
- content/learning material exchanges.

All suppliers would work to eU standards [A3:67].

Ideally, more than one set of material per topic would be made available [71].

Copyright access to e-journals an online books, which are likely to be used as additional resources, has been seen as posing a potential problem [90].

It is hoped that the 'not invented here' syndrome will be defeated over time as institutions become happier to source material from various external sources [96].

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